



Effectiveness of dialectical behavior therapy (DBT) on blood serotonin levels and cognitive-emotional regulation in drug abusers

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Received: 2021/4; Revised: 2021/9; Accepted: 2021/10

Abstract

Drug abuse leads to physical and psychological problems. Considering the negative and increasing consequences of drug abuse disorder in the community and the importance of this issue, we decided to investigate the efficacy of psychological therapies on reducing drug abuse disorder. This study aimed at the efficacy of dialectical behavioral therapy on blood serotonin levels and cognitive-emotional regulation among drug abusers. It was a quasi-experimental study with a pretest-posttest design and control group. The statistical population consisted of all men with drug abuse referring to Torbat Heydariyeh Adult Drug Abuse Clinic, 40 of whom were selected by simple random sampling for the experimental group (DBT) and a control group. The experimental group was trained for 10 sessions of 90 minutes per week, but the control group was on the waiting list and received no training. Demographic questionnaire, cognitive emotion regulation questionnaire was developed by Granefski and in vitro serum levels of serotonin were used for data collection before and after the intervention. Data were analyzed using the analysis of covariance in SPSS 24 software. The results of multivariate analysis of covariance showed that in the groups of dialectical behavioral therapy, intervention on cognitive-emotional regulation and blood serotonin had a significant effect on post-test ($P < 0.05$). According to the findings, dialectical behavioral therapy was effective in elevating blood serotonin and cognitive-emotional regulation among drug abusers.

Key words: Dialectical behavioral therapy, Blood serotonin level, Cognitive emotional regulation, Drug abuse.

Introduction

Drug abuse is the frequent and prolonged use of a drug where depriving of it causes an uncontrollable desire to reuse it, leading to physical and psychological problems. Drug dependence is a global problem, and statistics from international organizations, notably the World Health Organization, the World Narcotics Control Committee, and UNESCO, indicate increasing use of drugs worldwide [1]. Every year, many people with drug abuse disorders lose their lives through the direct and indirect consequences of it [2]. Drug abuse is a set of cognitive, behavioral, and psychological

symptoms of repeated use that lead to tolerance, abandonment, and coercive acts [3].

Mental and personality problems can be the cause of substance abuse, and most studies have reported concurrent drug abuse and mental disorders. Ignoring mental disorders before and after quitting is one of the factors that lead to treatment failure and drug reuse [4].

Lack of cognitive-emotional regulation is one of the major problems with other drug abusers. People with no cognitive-emotional adjustment are more likely to be at risk for drug abuse than others. Emotion regulation is an important

motivation for consuming or not consuming drugs. Drug users often attribute their consumption to the relieving effects of the drug [5]. Reports also indicated that drug and tobacco use increases when people are angry, anxious, sad, and distressed. Effective emotion management reduces the risk of drug abuse when one is pressured to use drugs. The ability to manage emotions enables one to use appropriate coping strategies in situations where the risk is high. People with high emotion regulation are more capable of anticipating what others want. They understand the unwanted pressures of others and better control their emotions, thereby making them more resistant to drug use. In contrast, those with lower emotion regulation tend to move toward drug abuse to counteract their negative emotions [6].

One of the causes of the disorder in the serotonergic system is long-term drug abuse which may cause comorbidity of drug use [7]. Serotonin is a neurotransmitter that plays an important role in one's mood, sexual behavior, sleep, pain, and aggressive power. One of the hormonal abnormalities in drug abuse is the disruption of the serotonin secretion process due to psychological problems [8]. In addition to medication therapy, numerous cognitive interventions have been devised over several consecutive years to address psychological problems, including anxiety. Psychological interventions are ways of communicating with positive, negative, and neutral experiences. These techniques help people to identify involuntary patterns of mind and turn them into conscious and voluntary patterns to perceive negative emotions and thoughts as simple, transient matters in the mind [9].

People with drug abuse lack emotional control and show abnormalities in the body's hormones and these are the same things that are taught in dialectical behavior therapy. Moreover, in this therapy, the patient's recurrence is also confirmed and prevents the patient from experiencing negative emotions of a particular situation [10].

Dialectical Behavioral Therapy (DBT) is a type of cognitive-behavioral therapy developed by Marshall Linnen for the treatment of people with chronic suicidal behavior, which comprises

four sections: Individual Learning Skills, Group Learning Skills, Telephone Counseling, and a Therapist Counseling Group. Lenin's fundamental assumption in the formulation of dialectical behavior therapy was that individuals with no cognitive-emotional adjustment lack the skills needed to solve their problem and this causes severe problems in patients [11].

Standard dialectical behavior therapy protocols include the essential skills associated with treating drug abuse disorders. For patients with drug abuse disorder, these basic skills are learned in standard form. These skills are used to cope with temptation and reduce the risk of return and include mindfulness, distress tolerance, emotion regulation, and interpersonal skills. Dialectical behavior therapy enhances positive body image and increases self-efficacy in individuals, including those with abuse disorders [12].

Therefore, considering the negative and increasing consequences of drug abuse disorder in the community and the importance of this issue as well as the effective role of psychological therapies in reducing drug abuse disorder, we decided to investigate the efficacy of dialectical behavior therapy on changes in blood serotonin levels and cognitive-emotional regulation among drug abusers.

This study aimed at the efficacy of dialectical behavioral therapy on blood serotonin levels and cognitive-emotional regulation among drug abusers.

Materials and Methods

It was a semi-experimental study with pre-test and post-test and control group design. The statistical population consisted of all men with drug abuse disorder after detoxification referring to Bozorgmehr Addiction Treatment Center in Torbat Heydariyeh, Iran.

Simple random sampling was used and 40 people were selected from the records of people referred to the addiction treatment center of Torbat Heydariyeh, based on a statistical formula, as well as similar studies [13]. They were selected and divided into experimental groups (DFT) and one control group. Entry criteria include no psychiatric illnesses and mental disorders except

drug abuse, written consent and willingness to attend therapy sessions, male gender, negative chromatography test for addiction, minimum of high school education, and a maximum of a bachelor degree, between 20 and up to 40 years old [14], not attending other psychotherapy sessions and the Anonymous Addicts Association, having drug addiction for at least 12 months [15]. Exclusion criteria included the absence of more than two sessions, lack of interest and cooperation with individuals and failure to perform specified tasks in the educational process, taking drugs that affect the variables of serotonin including Cortisone, anxiolytic and antidepressant drugs.

The research instrument included a demographic questionnaire, cognitive emotion regulation questionnaire was developed by Granefski, and an in vitro measurement of blood serotonin levels. The cognitive emotion regulation questionnaire was developed by Granefski [16], as a self-report instrument with 36 items. Scale scores ranged from 1 rarely up to 5 almost always. Each subscale consists of 4 items and the sum of the subscales is totaled. The questionnaire is scored based on a five-point Likert scale, never (1), rarely (2), sometimes (3), often (4), always (5). Interpretation of the questionnaire was based on the scale of the questionnaire so that a score between 36 and 72 indicates poor emotional cognitive adjustment, a score between 72 to 108 represents moderate emotional cognitive adjustment and a score above 108 represents a strong emotional cognitive adjustment in individuals. The alpha coefficient for the subscales of this questionnaire was reported by Granefski et al in a range of 0.71 to 0.81. Hasani et al. obtained the reliability of the questionnaire using Cronbach's alpha to be 92% [17]. To investigate convergent and divergent validity of the questionnaire in Iran, the use the depression, anxiety, and stress scale which includes 21 items that assessed the three factors of depression, stress, and anxiety. In this scale, each factor assesses the emotional disorder factor. After selecting the sample size and explaining the objectives of the study, informed consent was obtained from the participants, divided into the experimental and control group.

To measure serum serotonin levels, 5 ml of venous blood samples were collected at 8 am in a sterile dry tube and sent to the laboratory. Blood serotonin levels were assessed by ELISA using an IBL kit made in Germany. The experimental group received dialectical behavior therapy but the control group was on the waiting list and received no training. Training sessions were delivered in 10 sessions of 90 minutes per week, according to Table 1. Homework was assigned to each group for each session. The control group was treated in the same current and usual way (methadone maintenance therapy) and did not receive these interventions until the end of the research process. The control group was assured that they would receive the intervention after completing the research process. Immediately after the end of the training sessions, a post-test was conducted for serum serotonin levels and cognitive emotion regulation.

Urine chromatography tests were performed according to MMT protocol during the training sessions. They were also reassured that their information was kept confidential and that no harm was caused to them. Data were analyzed by SPSS software (version 24). Data analysis was performed in two levels of descriptive statistics and inferential statistics using analysis of covariance.

Results and Discussion

The mean age of the participants was 33 years, the majority of them were single (53%), and the majority had a diploma (46%) and the most consumed drug was Methamphetamine (40%). The mean and standard deviation of the two variables in the pre-test and post-test in the dialectical behavior therapy experimental group and control group, respectively, are shown in Table 2.

In this study, multivariate analysis of covariance was used for the inferential analysis of results. The main assumptions of the multivariate analysis of covariance analysis were: 1- Normal distribution of scores, 2- homogeneity of variances, 3- Equality of scores of covariance, 4- Homogeneity of regression slope.

Table 1: Content of dialectical behavior therapy sessions

Session	content
First session	Initial familiarity, statement of purpose of training sessions, duration, number of sessions, pre-test implementation (filling in the Demographic and cognitive emotion regulation questionnaire), and sample collection for blood serotonin levels.
Second session	Overcoming the obstacles of healthy emotions and giving hope skills so that one can understand how emotions affect their thoughts and behaviors.
Third session	Reducing physical vulnerability to disruptive emotions and how people's thoughts and behaviors can affect their emotions.
Fourth Session	Reducing cognitive vulnerability and understanding how thoughts affect feelings.
Fifth session	Increasing positive and pleasant emotions (such as happiness) and overcoming negative emotions (such as anger, fear, and sadness).
Sixth Session	Conscious awareness of emotions without judgment (learning to control emotions consciously without judging them, reducing the chances of exacerbation, problems, and emotional distress).
Seventh Session	Coping with emotions (dealing with emotions rather than evading them, which is one of the main goals of the dialectical behavior therapy approach).
Eighth Session	To act against the overwhelming emotion and why we need to understand the feeling.
Ninth Session	Problem Solving (before turbulent feelings become active, emotion regulation).
Tenth session	Receive feedback from team members on the principles taught, reviewing and summarizing past material, and post-test implementation (Evaluation of blood serotonin levels and cognitive emotion regulation questionnaire).

The results of Kolmogorov-Smirnov test showed that the distribution of communities was normal ($P > 0.05$). The results showed that in the post-test stage, there was a difference in the cognitive emotion regulation variable ($P = 0.143$) and serotonin ($P = 0.621$). Box test was used to test the equality of covariance. Box test results were obtained for the heterogeneity of variance-covariance matrices ($P = 0.182$), which confirmed the default covariance equality in all analyzes. To investigate the homogeneity of the regression slope assumption, the interaction

between dependent and covariate variables was investigated. The results of this analysis showed that this interaction was not significant in cognitive emotion regulation ($P = 0.589$) and in serotonin ($P = 0.243$) indicating slope homogeneity assumption. Since all assumptions were confirmed, analysis of the covariance method can be used to investigate the research hypotheses.

Table 2: Descriptive statistics of variables studied by different variables and test type

variables		DBT Group	Control Group
		Mean \pm SD	Mean \pm SD
Blood Serotonin Levels	Pre Test	158.80 \pm 13.53	164.00 \pm 14.81
	Post Test	183.73 \pm 15.78	165.40 \pm 15.61
Cognitive Emotion Regulation	Pre Test	72.07 \pm 7.94	67.066 \pm 8.79
	Post Test	80.27 \pm 13.49	66.072 \pm 7.17

According to Analysis of covariance, with the elimination of the effect of pre-test scores, the difference between the mean of post-test scores in the variables of cognitive emotion regulation and serotonin levels was significant in the dialectical behavior therapy and control groups ($P < 0.05$). The effect of this treatment on increasing cognitive emotion regulation score

was 23% and 43% on serotonin levels. The statistical power of 0.99 indicated that the sample size was sufficient for this conclusion.

Analysis of covariance results showed that this treatment had a significant effect on increased blood serotonin and cognitive emotion regulation score. Concerning the efficacy of dialectical behavior therapy on serotonin level,

the results of the present study are in line with the results of [18] and [19]. The results of the effects of dialectical behavior therapy on cognitive emotion regulation were also consistent with the studies by [20-22] and [11].

Dialectical behavior therapy exercises can be effective in reducing negative thoughts and emotions and stress and can lead to increased self-efficacy and performance in people with drug abuse. The effectiveness of these exercises on performance enhancement and related factors, including attention and concentration, control, anxiety, and other factors have been shown in some studies [23]. Given the effects of negative emotions on people with drug abuse, high levels of these emotions appear to lead to impaired functioning. Drug addicts who have impulse control problems are increasingly impulsive and irresponsible and cognitively cluttered. As they lack rational thinking, they cannot pay attention to the consequences of their actions. Therefore, one of the reasons for the success of dialectical behavior therapy has been to reduce the suffering of people with emotional and hormonal problems, which has reduced the abnormal emotions of these individuals [24].

In explaining the results, it can be argued that the drug abusers always avoid acceptance of their addiction by using the defense mechanism of denial. Since the goal of dialectical behavior therapy is to create a balance between change and acceptance, besides the emphasis on reference change, the patient's recurrence is emphasized and prevents negative emotions from the patient's condition make him/her dis-functioning. Basic acceptance skills teach these people to change behaviors that cause them more suffering for themselves or others while embracing their strengths and emotions, discovering their values, and coping with stressful situations by getting help from them and making their lives more satisfying by committing and implementing their promises.

The results of the effects of dialectical behavior therapy on serotonin levels were also consistent with the studies by [18] and [19].

Psychological stimulators, such as negative emotions in drug abusers, inhibition of serotonin reabsorption. Various researches have shown that

Psychological therapies such as dialectical behavior therapy create behaviors similar to the effects of psychotropic drugs. Serotonin has 14 receptors, that among them the 5HT1B receptor determines the final pathway and releases serotonin and causes psychological stimulation [25] Different areas of the brain are damaged by drug abuse, but serotonergic and dopaminergic disorders usually occur together and reduce the transfer of serotonin and dopamine.

Dialectical behavioral therapy uses behavioral techniques such as imaginary and real exposure to reduce negative mental image and by using regular desensitize, it reduces anxiety and causes feelings of satisfaction and completeness, so dialectical behavior therapy can be effective in changing individual positive attitudes and can affect certain levels of serotonin and dopamine transporters [26].

Limitations of this study included the inability to control variables such as drug use, lack of follow-up, the limited community of drug abusers. The strengths of this study included the high accuracy of the laboratory apparatus for measuring blood serotonin levels, the regularity of classes held, the willingness of test group participants to attend meetings, and even follow-up their study results. According to the results of this study, dialectical behavioral therapy increased blood serotonin and cognitive-emotional regulation in drug abusers, so, it is recommended to use this treatment in drug addiction clinics and counseling centers.

As in drug abuse disorder, detoxification comprises only 3% of the total treatment, and the remaining 97% is psychologically dependent on drug use [27]. Psychological therapies can be of great help in treating drug abuse disorders. Among these therapies is the dialectical behavioral therapy that was used in this study and according to the results, it increased blood serotonin and cognitive emotion regulation score in people with drug abuse disorder. Therefore, considering the low cost and effectiveness of this treatment in improving psychological symptoms, it is recommended to use these treatments in the post-detoxification period.

Acknowledgments

This article was an original research project approved by the Islamic Azad University of Neyshabur Branch. Thanks to the hard work of the study participants and the respected authorities of the large drug addiction clinic in Torbat Heydariyeh who helped us in this project.

Footnotes

Authors' Contribution: All the authors met the standard criteria of authorship based on the recommendations of the international committee of medical journal editors.

Conflict of Interests: Hereby, the authors declare that there is no conflict of interest regarding the present study.

Funding/Support: No funds have been received for doing this project.

Informed Consent: Participants were enrolled in the study after signing an informed consent form.

References

- Vsevolozhskaya OA, Anthony JC. Transitioning from First Drug Use to Dependence Onset: Illustration of a Multiparametric Approach for Comparative Epidemiology. *Neuropsychopharmacology: official publication of the American College of Neuropsychopharmacology*. 2016;41(3):869-76.
- Bagot KS, Berarducci JM, Franken FH, Frazier MJ, Ernst M, Moolchan ET. Adolescents with conduct disorder: Early smoking and treatment requests. *American Journal on Addictions*. 2007;16(1):62-6.
- Salimi S, Hagh NA, Ahmaditahour SM, Zohreh VM. The effectiveness of Mindfulness-Based Cognitive Therapy (MBCT) on drug craving in heroin addicts treated by methadone maintenance. 2016.
- Dinas PC, Koutedakis Y, Flouris AD. Effects of exercise and physical activity on depression. *Irish journal of medical science*. 2011;180(2):319-25.
- Weems CF, Pina AA. The assessment of emotion regulation: Improving construct validity in research on psychopathology in youth—An introduction to the special section. *Journal of Psychopathology and Behavioral Assessment*. 2010;32(1):1-7.
- Snyder DK, Balderrama-Durbin C, Fissette CLJC, Research FP, Practice. Treating infidelity and comorbid depression: A case study involving military deployment. 2012;1(3):213.
- Fink KB, Göthert M. 5-HT receptor regulation of neurotransmitter release. *Pharmacological reviews*. 2007;59(4):360-417.
- Kirby L, Zeeb F, Winstanley C. Contributions of serotonin in addiction vulnerability. *Neuropharmacology*. 2011;61(3):421-32.
- Dimeff LA, Linehan MM. Dialectical behavior therapy for substance abusers. *Addiction science & clinical practice*. 2008;4(2):39.
- Linehan MM, Dimeff LA, Reynolds SK, Comtois KA, Welch SS, Heagerty P, et al. Dialectical behavior therapy versus comprehensive validation therapy plus 12-step for the treatment of opioid dependent women meeting criteria for borderline personality disorder. *Drug and alcohol dependence*. 2002;67(1):13-26.
- Kröger C, Schweiger U, Sipos V, Kliem S, Arnold R, Schunert T, et al. Dialectical behaviour therapy and an added cognitive behavioural module for eating disorders in women with borderline personality disorder and anorexia nervosa or bulimia nervosa who failed to respond to previous treatments. An open trial with a 15-month follow-up. *Journal of behavior therapy and experimental psychiatry*. 2010;41(4):381-8.
- Linehan MM. *Dialectical behavior therapy in clinical practice*: Guilford Publications; 2020.
- Ghodrati Torbati A, Nejat H, Toozandehjani H, Samari AA, Akbari Amarghan H. Effect of Compassion-Focused Therapy (CFT) on Blood Cortisol and Cognitive-Emotion Regulation in Drug Abusers. *Jundishapur Journal of Health Sciences*. 2020;12(1).
- Hsiao F-H, Jow G-M, Lai Y-M, Chen Y-T, Wang K-C, Ng S-M, et al. The long-term effects of psychotherapy added to pharmacotherapy on morning to evening diurnal cortisol patterns in outpatients with major depression. 2011;80(3):166-72.
- Ghodrati Torbati A, Sahbaei F, Nabavi SJ, Zare M. Comparing continuity quit addiction time in participant persons and non participant persons in Narcotics Anonymous in City of Mashhad in 2012. *Medical Science Journal of Islamic Azad University-Tehran Medical Branch*. 2013;23(3):201-5.
- Garnefski N, Kraaij V. Cognitive emotion regulation questionnaire—development of a short 18-item version (CERQ-short). *Personality and individual differences*. 2006;41(6):1045-53.
- Hasani J, Azadfalsh P, Rasoulzade Tabatabaei K, Ashayeri H. The assessment of cognitive emotion regulation strategies according to neuroticism and extraversion personality dimensions. *Advances in Cognitive Science*. 2009;10(4):1-13.
- Romanelli RJ, Wu FM, Gamba R, Mojtabei R, Segal JB. Behavioral therapy and serotonin reuptake inhibitor pharmacotherapy in the treatment of obsessive-compulsive disorder: A systematic review and meta-analysis of head-to-head randomized controlled trials. *Depression and anxiety*. 2014;31(8):641-52.
- Soetrismo S, Sulistyowati S, Respati SH, Nasrudin M. Effect of cognitive behavioral therapy for serotonin level, depression score and quality of life in cervical cancer patients. *Folia Medica Indonesiana*. 2017;52(3):231-4.
- Axelrod SR, Perepletchikova F, Holtzman K, Sinha R. Emotion regulation and substance use frequency in women with substance dependence and borderline personality

disorder receiving dialectical behavior therapy. *The American journal of drug and alcohol abuse*. 2011;37(1): 37-42.

21. Neacsiu AD, Eberle JW, Kramer R, Wiesmann T, Linehan MM. Dialectical behavior therapy skills for transdiagnostic emotion dysregulation: A pilot randomized controlled trial. *Behaviour research and therapy*. 2014;59:40-51.

22. Feldman G, Harley R, Kerrigan M, Jacobo M, Fava M. Change in emotional processing during a dialectical behavior therapy-based skills group for major depressive disorder. *Behaviour research and therapy*. 2009;47(4): 316-21.

23. Zeidan F, Gordon NS, Merchant J, Goolkasian P. The effects of brief mindfulness meditation training on experimentally induced pain. *The Journal of Pain*. 2010;11(3):199-209.

24. Zamani N, Farhadi M, Jamilian HR, Habibi M. Effectiveness of group dialectical behavior therapy (based on core distress tolerance and emotion regulation

components) on expulsive anger and impulsive behaviors. *Journal of Arak University of Medical Sciences*. 2015;17(11):53-61.

25. Miszkiel J, Filip M, Przegaliński E. Role of serotonin (5-HT) 1B receptors in psychostimulant addiction. *Pharmacological Reports*. 2011;63(6):1310-5.

26. Krasnova IN, Ladenheim B, Hodges AB, Volkow ND, Cadet JL. Chronic methamphetamine administration causes differential regulation of transcription factors in the rat midbrain. *PLoS One*. 2011;6(4):e19179.

27. Weinberg TS. *The sociology of addiction*. Encyclopedia of Life Support Systems (EOLSS) Oxford, UK: Eolss Publishers Developed under the Auspices of the UNESCO. 2012.